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*“Draft Environmental Impact Statement
for a Geologic Repository for the
Disposal of Spent Nuclear Fuel and
High-Level Radioactive Waste at Yucca
Mountain, Nye County, Nevada”*

Presentation to the
Nuclear Regulatory Commission
September 21, 1999

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Presentation to the Nuclear Regulatory Commission

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Yucca Mountain - 70

Environmental Impact Statement (EIS) Drivers

Nuclear Waste Policy Act (NWPA)

- Requires a final EIS to accompany a site recommendation and license application
- Prepare a technically adequate EIS that can be adopted, to the extent practicable, by the Nuclear Regulatory Commission
- EIS need not consider
 - The need for a repository
 - The time of initial availability of a repository
 - Alternatives to geologic disposal
 - Alternative sites to Yucca Mountain

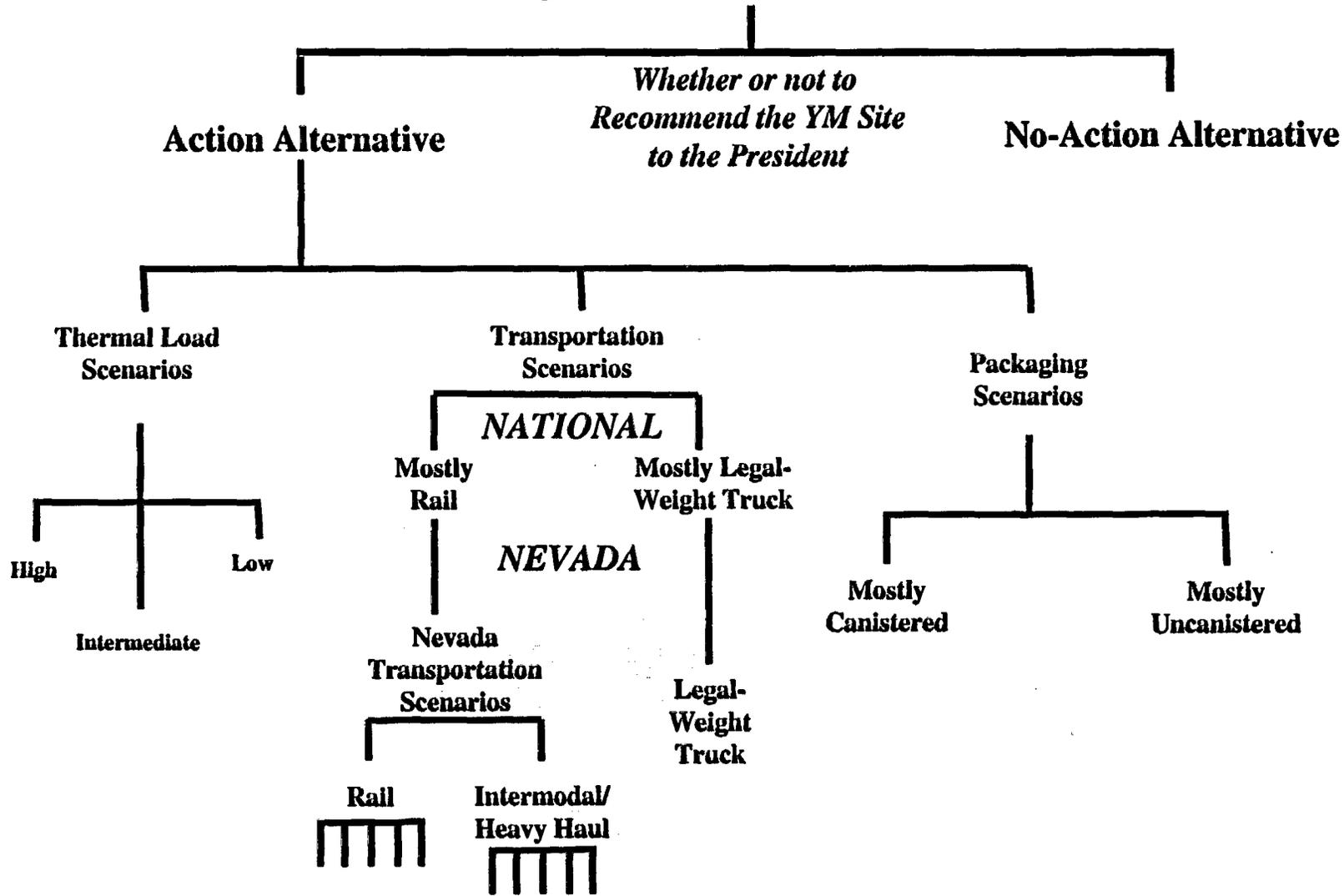
Preparation of the EIS

- DOE is lead agency for preparing the EIS
 - EIS Technical Support Contract under DOE - Jason Associates and subcontractors:
 - Tetra Tech NUS
 - Battelle
 - Dade Moeller and Associates
 - Relied on existing technical studies and information developed during site characterization activities by the CRWMS M&O Contractor, USGS and National Laboratories
 - Developed new information as necessary to supplement existing information

Proposed Action

- DOE proposes to construct, operate and monitor, and eventually close a geologic repository for the disposal of spent nuclear fuel and high-level radioactive waste
- 70,000 metric tons of heavy metal (MTHM)
 - 63,000 MTHM commercial Spent Nuclear Fuel (SNF)
 - 7,000 MTHM DOE SNF and High-Level Waste (HLW)
- The EIS describes and evaluates the current preliminary design concept and also identifies design features and alternative design concepts that DOE is considering for the final design

Analytical Structure



Cumulative Impacts

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graph TD; A[Cumulative Impacts] --- B[Modules]; A --- C[Transportation]; A --- D[Other Cumulative Impacts]
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Modules

Module 1

- 119,000 MTHM
 - 105,000 CSNF
 - 2,500 DOE SNF
 - 11,500 HLW

Module 2

- 119,000 MTHM
 - 105,000 CSNF
 - 2,500 DOE SNF
 - 11,500 HLW
- 2,100 m³ GTCC
- 4,000 m³ SPAR

Transportation

- All national radioactive waste shipments from 1943 to 2047
 - Medical
 - Research Labs
 - etc.
- Historic and future DOE waste shipments
- Shipment of Modules 1 and 2

Other Cumulative Impacts

- Nevada Test Site
- National transportation of radioactive materials
- Local mining
- Beatty low-level radioactive waste disposal
- Nellis Air Force Base
- Others

Areas of Analysis

- **Short Term Analyses**

Land Use and Ownership

Air Quality

Health and Safety

Accident Impacts

Utilities, Energy, Materials

Waste Management

Transportation

Environmental Justice

Hydrology

Floodplains/Wetlands

Biological Resources/Soils

Cultural Resources

Socioeconomics

Noise

Aesthetics

- Long-Term Repository Performance

- No Action Alternative

- Cumulative Impacts

Health and Safety

- **Primary sources of information**
 - DOE site data
 - Independent guidance organizations (National Council on Radiation Protection and Measurements (NCRP) and International Commission on Radiological Protection (ICRP))
 - DOE Computerized Accident/Incident Reporting and Recordkeeping System (CAIRS)
- **Potential impact sources**
 - Radionuclide releases and direct radiation
 - Cristobalite releases
 - Industrial accidents

Health and Safety (cont.)

- **Impact indicators**
 - Public (population and hypothetical maximally exposed individual (MEI))
 - Involved and noninvolved workers (population and hypothetical MEI)
- **Analytical Approach**
 - Cristobalite: estimate offsite concentrations and qualitatively evaluate involved worker exposure
 - Industrial: estimate worker full-time equivalents (FTE) and use DOE workplace fatality rate of 2.9 fatalities per 100,000 FTE
 - Radiation dose: estimate dose from radon-222 and progeny, krypton-85, external radiation from fuel and waste package handling, subsurface ambient external radiation
 - Convert public and worker dose estimates to human health impacts using ICRP-60 (2,000 rem = 1 latent cancer fatality (LCF) for public, 2,500 rem = 1 LCF for workers)

Health and Safety (cont.)

- Overview of impacts

- Hypothetical maximally exposed individual (public) - highest annual dose estimated at 0.8-1.8 mrem (> 99% radon-222) *low thermal load 20 km*
- Highest annual population dose 4-10 person-rem (> 99% radon-222)
- Radiological impacts to the public from repository activities could result in 280-810 person-rem or 0.14-0.4 LCF (> 99% radon) over 100 years
- Radiological impacts to workers could result in 6,500-9,800 person-rem or 3-4 LCFs (~70% from SNF and HLW management) over 100 years
- Industrial workplace hazards could result in up to 1-2 fatalities over 100 years

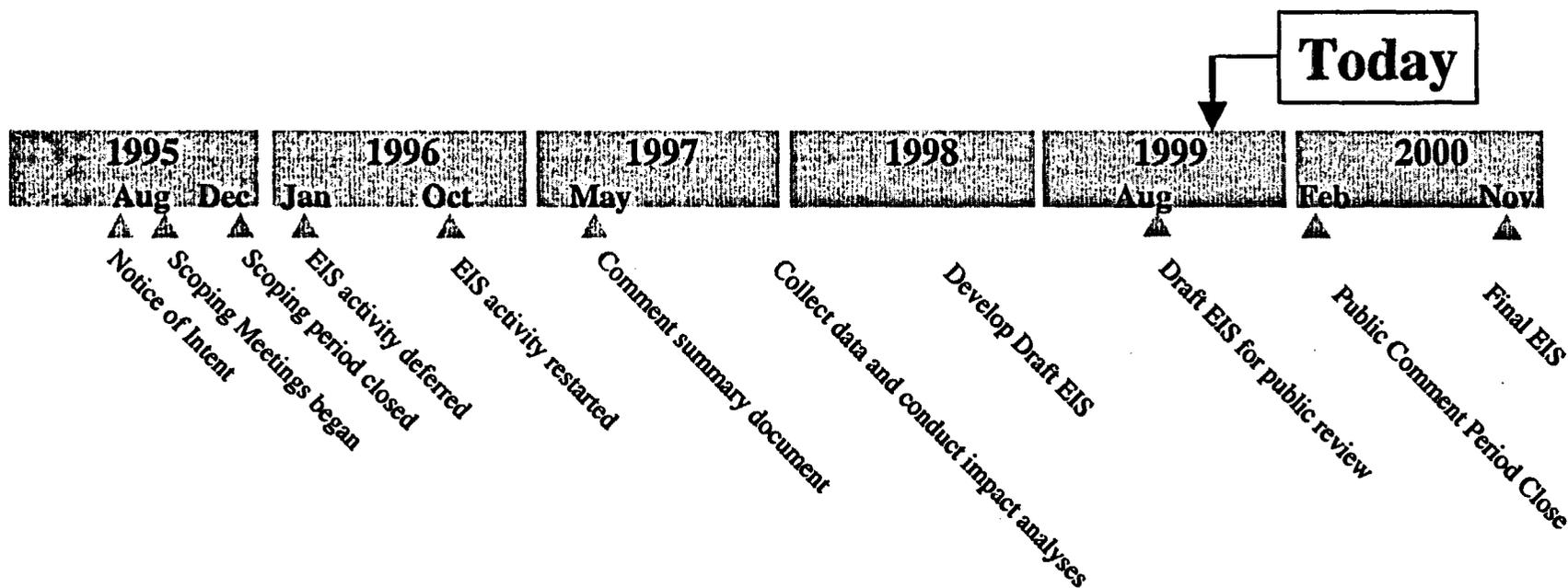
Accident Impacts

- **Primary sources of information**
 - DOE, Nuclear Regulatory Commission and other agencies
- **Potential impact sources**
 - Radionuclide releases and structural failures
- **Impact indicators**
 - Public, involved workers, and noninvolved workers
- **Analytical Approach**
 - 16 scenarios included in detailed analysis from 69 originally considered
 - Used the MACCS2 (MELCOR Accident Consequence Code System) code
 - Consequence analysis did not include probability of occurrence (accidents analyzed as if assumed to occur)

Accident Impacts (cont.)

- Overview of impacts
 - Maximum reasonably foreseeable accident is an earthquake estimated to occur once every 50,000 years (1.1g ground acceleration)
 - Highest dose to public MEI - 320 millirem (0.00002 probability of LCF)
 - Severe injury or death to involved workers from collapsed buildings
 - As many as 39 in Waste Handling Building and 36 in Waste Treatment Building

Timeline of Events



Transportation

- **Primary sources of information evaluated**
 - DOE (Studies, reports, and file information)
 - Department of Transportation and Census Bureau
 - State accident data
 - Other EISs
 - Nuclear Regulatory Commission
- **Impact indicators**
 - Workers (populations and hypothetical maximally exposed individual)
 - Public (Population within one-half mile of route and hypothetical maximally exposed individual, within 50 miles for accidents)
 - Other resource areas within Nevada (e.g., water, biology, socioeconomics)

Transportation (cont.)

- Analytical approach
 - CALVIN: Numbers of commercial SNF shipments
 - HIGHWAY and INTERLINE: Route data
 - RISKIND: MEI doses (routine); MEI & population doses (accident)
 - RADTRAN4: Dose to the public & workers (routine); dose risk from accidents
- Overview of impacts
 - Legal weight truck: About 60,000 person-rem or 29 LCFs and 11 traffic fatalities
 - Rail: About 5,100 person-rem or 6 LCFs and 16 traffic fatalities
 - Maximum reasonably foreseeable accident:
 - 9,400-61,000 person-rem or 5 to 31 latent cancer fatalities
 - Accident probability per year: 1.4×10^{-7} to 1.9×10^{-7}

Long-Term Repository Performance

- Primary sources of information evaluated
 - DOE reports, studies and data
 - Other EISs
 - National Research Council report Technical Basis for Yucca Mountain Standards
 - Viability Assessment
 - USGS and National labs
 - Environmental Protection Agency, International Atomic Energy Agency and ICRP technical reports
- Impact indicators
 - Public within 80 kilometer radius
 - Public within groundwater flow area

Long-Term Repository Performance (cont.)

- Analytical approach
 - Total System Performance Assessment simulated climate, water infiltration, the unsaturated zone, thermal hydrology, near-field geochemistry, cladding degradation, radionuclide mobilization and engineered barrier system transport, unsaturated and saturated zone transport, and biosphere pathways.
 - DOE also used alternate conceptual models, a contained gas release model, and Monte Carlo techniques to address aspects of uncertainty
 - Estimated doses to population within about 80 kilometers
 - Estimated population and hypothetical maximally exposed individual at four distances
 - 5, 20, 30, and 80 kilometers (Franklin Lake Playa)

Long-Term Repository Performance (cont.)

- Analytical approach (cont.)
 - Collective dose to LCF conversion: ICRP-60 (2,500 rem = 1 LCF for member of the public and 2,000 rem = 1 LCF for a worker)
 - Compared chemical impacts to Maximum Contaminant Levels (MCLs)
- Overview of impacts (at 20 kilometers)
 - Maximum exposed individual during 10,000 years - mean values
 - 0.059 to 0.22 mrem/year or
 $\ll 1$ LCF (2.1×10^{-6} to 7.6×10^{-6})
 - Population impacts during 10,000 years - mean values
 - 0.13 to 0.37 person-rem or
 $\ll 1$ LCF (6.7×10^{-5} to 1.8×10^{-4})
 - Chemical contaminant below MCLs during 10,000 years

Long-Term Repository Performance (cont.)

- Carbon-14
 - Maximum release rate (19,000 years)
 - 0.098 microcuries per year
 - Average dose to local individual
 - 7.8×10^{-12} mrem per year
 - Maximum population dose
 - 2.2×10^{-10} person-rem per year

No Action Alternative

- The EIS recognizes that the future course that Congress, the DOE, and commercial nuclear power utilities would take if Yucca Mountain were not recommended as a repository remains highly uncertain
- To provide a baseline for comparison with the Proposed Action, DOE decided to illustrate one set of possibilities by focusing its analysis of the No-Action Alternative on the potential impacts of two scenarios:
 - Long-term storage at the current storage sites with effective institutional controls for at least 10,000 years
 - Long-term storage at the current storage sites with no effective institutional controls after approximately 100 years

No-Action Alternative (cont.)

- Primary sources of information evaluated
 - DOE reports and data
 - Nuclear Regulatory Commission
 - National Environmental Policy Act documents
 - Total System Performance Assessment
- Impact indicators
 - Focused on human health
 - Hypothetical maximally exposed individual
 - Population doses
 - Workers - involved and noninvolved
 - Other resources were more qualitatively evaluated

No-Action Alternative (cont.)

- Analytical approach
 - SNF and HLW assumed to be in dry storage
 - Surface and below grade facilities
 - Stainless steel dry storage canisters with concrete shield
 - Hypothetical regions used to simplify analysis - mathematical constructs
 - Developed concrete storage module degradation model
 - Adopted three process models from Total System Performance Assessment
 - Storage canister degradation,
 - Cladding degradation, and
 - SNF & HLW dissolution

No-Action Alternative (cont.)

- Analytical approach (cont.)
 - Developed facility radioactive release model to estimate release of dissolution products to the local environment
 - MEPAS computer code used for
 - Groundwater, surface water, and air
 - Dose
 - Latent Cancer Fatalities

Senior Technical Panel Members

- Dade W. Moeller -- radionuclide multimedia transport, biosphere, and risk assessment
- Alan H. Wells -- spent nuclear fuel and high level radioactive waste storage container degradation
- Richard S. Denning -- waste form degradation and environmental release
- Stephen A. Short -- facility degradation and failure mechanisms
- Robert J Budnitz -- integrated performance assessment

No-Action Alternative (cont.)

- Overview of impacts
 - Repository - loss of jobs
 - Scenario 1 - Credit taken for institutional control
 - About 70,000 person-rem or 31 LCFs
 - About 1,100 commuting and worker accident fatalities
 - Scenario 2 - No credit for institutional control after 100 years
 - About 7 commuting and industrial accident fatalities during first 100 years
 - About 6,600,000 person-rem or 3,300 LCFs
 - Potential contamination of all 77 sites, and surrounding resources
 - Aircraft crash into degraded facility -
 - 6,000 - 26,000 person-rem or 3 - 13 LCFs

Cumulative Impacts

- **The incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future Federal and non-Federal actions**
 - National transportation of radioactive materials
 - Beatty Waste Disposal Area
 - Inventory modules (discussed earlier)
 - Nellis Air Force Range
 - Nevada Test Site
 - DOE complex-wide waste activities affecting the Nevada Test Site
 - Low-level waste intermodal transfer station at Caliente
 - Proposed Timbisha Shoshone Reservation
 - Cortez pipeline gold deposit projects
 - Apex bulk commodities intermodal transfer station
 - Shared use of DOE branch rail line

Cumulative Impacts (cont.)

- Primary sources of information evaluated
 - DOE data and reports, other EISs, Native American tribes and Federal, state, and local government agencies
- Impact indicators
 - Same as used for other analysis of resource impacts
- Analytical approach
 - Analytical models and tools from other studies provided data to this study

Cumulative Impacts (cont.)

- Overview of impacts
 - Low short-term impacts in some study areas; cultural resources, aesthetics, and electrical power supply
 - Long-term impacts from toxic and radiological and same level atmospheric radioactive releases would increase incrementally
 - Incremental increases in groundwater transport of radionuclides (from NTS) could also occur (0.2 millirem per year dose to the MEI)
 - Less than 1% increase in LCFs when combined with other national transportation activities
 - Potential for small transportation impacts increase at Caliente (potential private LLW intermodal transfer site)
 - Cask manufacturing could increase impacts
 - Potential for small increase in impacts with the Carlin rail corridor implementing alternative (Cortez Gold Mine, Inc. - pipeline projects)

Other Areas of Analysis

- **Land Use and Ownership**
 - EIS assumption: Permanent withdrawal of 150,000 acres now under federal control
 - Active use (surface disturbance) of 870 acres until closure
 - 0 to 5000 acres of land disturbed for Nevada transportation
- **Air Quality**
 - Criteria pollutants <5 percent of regulatory limits
 - Cristobalite exposure estimated at <0.026 microgram per cubic meter for public hypothetical MEI

Other Areas (cont.)

- **Utilities, Energy, Materials and Site Services**
 - Use of energy, materials, and community services would be small in comparison to amounts used regionally
 - Transmission lines to site would require some form of upgrade
- **Waste Management**
 - Radioactive and hazardous waste generated would be a few percent of existing offsite capacity
 - Solid wastes would be managed offsite or potentially at an onsite landfill
 - Hazardous waste would be shipped offsite for disposal
 - Low-level radioactive waste could be shipped to Nevada Test Site for disposal
 - Generation of mixed waste could only occur in unusual circumstances

Other Areas (cont.)

- **Biological Resources/Soils**
 - 870 acres disturbed at the repository
 - 0 to 5000 acres of land disturbed for Nevada transportation
 - Impacts to plants and animals and habitat localized
 - Impacts to wetlands and soils small
 - Some individual tortoises anticipated to be killed
 - Localized vegetation and animal community shifts possible from temperature changes
- **Floodplains/Wetlands**
 - Small effect to floodplains in Yucca Mountain area
 - No effect to wetlands
 - Along rail corridors, effects to floodplains and wetlands would be small
 - Additional floodplain/wetland assessment may need to be done when more information is available upon selection of a rail corridor or heavy-haul route

Other Areas (cont.)

- **Cultural Resources**
 - Disturbance of about 870 acres at the repository
 - 0 to 5000 acres of land disturbed for Nevada transportation
 - Activities at repository could cause damage to and illicit collecting at nearby sites; programs in place to minimize impacts
 - Studies likely needed along transportation corridor
- **Socioeconomics**
 - Estimated peak repository employment of 2,400 (direct and indirect) occurring in 2006 would result in <1 percent in regional employment
 - Estimated peak transportation construction employment would range from less than 1 percent to 5.7 percent of total employment by county

Other Areas (cont.)

- **Noise**
 - Low impacts expected from repository, rail construction or transportation activities
- **Aesthetics**
 - Low adverse effects to visual or scenic resources in the region of the repository or from transportation
- **Environmental Justice**
 - No disproportionately high and adverse impacts to minority or low-income populations or persons with subsistence lifestyles

Other Areas (cont.)

- **Hydrology**
 - Small effect on recharge and on floodplains & drainage channels (Additional delineations will likely be needed)
 - Repository water demand (250 to 480 acre-feet per year) below Nevada State Engineer's ruling on perennial yield (low 580 acft/yr)
 - Withdrawal of 320-710 acre-feet from multiple wells and hydrographic areas over 2.5 years for rail construction

SUMMARY

- DEIS assesses
 - Impacts of constructing, operating and monitoring, and eventually closing a geologic repository at Yucca Mountain
 - Potential long-term impacts of repository disposal
 - Potential impacts of transporting the high-level radioactive waste and spent nuclear fuel nationally and in the State of Nevada
 - Potential impacts of not proceeding with the Proposed Action.
- DEIS was distributed to the public on August 6, 1999
- Federal Register Notice of Availability published August 13, 1999
- An 180 day public comment period, with national and Nevada meetings to receive public comments, is planned.

DEIS Public Hearings

- 9/27 Amargosa Valley, NV
- 9/30 Pahrump, NV
- 10/4 Goldfield, NV
- 10/5 Boise, ID
- 10/19 Ely, NV
- 10/21 Atlanta, GA
- 10/26 Washington, DC
- 11/4 Lone Pine, CA
- 11/9 Caliente, NV
- 11/16 Denver, CO
- 12/1 Reno, NV *12/2 Carson City*
- 12/7 Austin, NV
- 12/9 Crescent Valley, NV
- 1/11 Las Vegas, NV, NV
- 1/13 Salt Lake City, UT
- 1/20 St. Louis, MO

Timeline of Events

